Information Disclosure Statement

Disclosure from ISA report:

GB2243552

Patent number:	GB2243552
Publication date:	1991-11-06
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Classification:	A61M5/32; A61M5/50
Application number:	GB19900006383 19900321

Abstract of GB2243552

Single-use syringes comprising a cylinder 1, piston and probe 11 have one or more of the following features to prevent reloading after ejection of the contents: (1) a one-way valve 31' to inhibit inward flow of liquid (2) a coupling between the piston rod and piston head which acts only in compression (during the ejection stroke), the probe being retracted after ejection (3) a telescopic sleeve 3 on the cylinder which, when extended, shields the probe and when retracted loads a spring 27 which drives the probe back into the cylinder after ejection (4) a coupling between the piston rod and piston head which allows initial loading and ejection but prevents subsequent reloading (5) means for bending the probe when it is retracted after ejection so that it is misaligned with the retraction aperture in the cylinder and cannot be extended again for reloading.

(12) UK Patent Application (19) GB (11) 2 243 552 (13) A

(43) Date of A publication 06.11.1991

(21) Application No 9006383.5

(22) Date of filing 21.03.1990

(51) INT CL[5]
A61M 5/50 5/32

(52) UK CL (Edition K)
A5R RGG RGM RGP

(56) Documents cited
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US 4795432 A US 4752290 A US 4747829 A

(58) Field of search
UK CL (Edition K) A5R RCQ RGD RGG RGM
INT CL[5] A61M 5/178 5/32 5/34 5/50
Online databases: WPI

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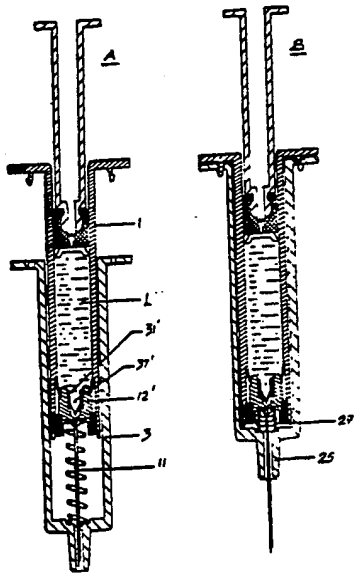
(54) Improvements in or relating to single-use syringes

(57) Single-use syringes comprising a cylinder 1, piston and probe 11 have one or more of the following features to prevent reloading after ejection of the contents:
(1) a one-way valve 31' to inhibit inward flow of liquid
(2) a coupling between the piston rod and piston head which acts only in compression (during the ejection stroke), the probe being retracted after ejection
(3) a telescopic sleeve 3 on the cylinder which, when extended, shields the probe and when retracted loads a spring 27 which drives the probe back into the cylinder after ejection
(4) a coupling between the piston rod and piston head which allows initial loading and ejection but prevents subsequent reloading
(5) means for bending the probe when it is retracted after ejection so that it is misaligned with the retraction aperture in the cylinder and cannot be extended again for reloading.

FIG 2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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IMPROVEMENTS IN OR RELATING TO SYRINGES

This invention relates to syringes, and particularly to syringes which are adapted with the intention that they can be used only once.

With the spread of the AIDS HIV virus over recent years, research into the causes for its transfer from one human being to another established some time ago that the common practice among groups of drug addicts of sharing syringes and syringe needles for the injection of drugs presented one of the most serious sources of spread of this and various other diseases. Although there have been many proposals for constructions of syringe which are intended to prevent multiple-use, the need amongst drug-dependent people to inject themselves represents a strong incentive to overcome the measures used in these known arrangements, and in general drug addicts have been very successful in adapting their techniques of injection so as to enable them to share the use of these so-called "single-use" syringes.

Also, the problem arises in the legitimate use of syringes by medical personnel in hospitals, clinics etc that once a syringe has been used, the exposed needle presents a serious hazard both as a dangerously

sharp implement which could cause accidental injury, and also as a carrier of any infection which may be present in the small quantity of blood remaining on the needle after injection. Hitherto, this problem has been tackled by the provision of special non-openable containers into which the used syringes, or at least the needles therefrom, are deposited after use, for subsequent safe disposal. However, in order to be fully effective, these measures require the medical personnel to comply with a strict regime for the use and handling of syringes, and also are dependent upon regular replacement of the special disposal containers. These elaborate procedures are therefore costly and inefficient.

The present invention, in its various aspects, aims to alleviate at least partly the above problems in syringe usage.

According to a first aspect of the invention, there is provided a syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the container by movement of the piston, wherein there is also provided a valve arranged for or capable of one-way operation for passing the liquid to be ejected, and for inhibiting the inward flow of liquid into the

container from the probe.

According to a second aspect of the invention there is provided a syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the tubular container by movement of the piston, wherein the piston includes a slidable piston head and a piston rod coupled to the piston head by a coupling which is operable to act only one-way in compression to push the piston head for ejection of the liquid, thereby to inhibit subsequent re-loading of liquid into the tubular container, and wherein there is provided means for retracting the probe into the tubular container after operation of the syringe for liquid ejection.

According to a third aspect of the invention there is provided a syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from said tubular container by movement of the piston, wherein there is provided a tubular sleeve fitted telescopically on the tubular container and arranged in a telescopically extended position thereof to shield the probe extending from the tubular container, spring means being arranged to be loaded by the telescopic retraction of the sleeve

relative to the tubular container for exposure of the probe, the probe being arranged to retract into the tubular container by the action of the loaded spring.

According to a fourth aspect of the invention there is provided a syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the tubular container by movement of the piston, wherein the piston includes a slidable piston head and a piston rod coupled to the piston head by a coupling which is operable to act only one-way in compression to push the piston head for ejection of the liquid, thereby to inhibit subsequent re-loading of liquid into the tubular container, said coupling comprising a connector which is attached to and projects from one end of the piston rod, and which includes a plurality of outwardly-facing, inwardly-deflectable claws arranged in their relatively outwardly-projecting positions to engage with complementary engagement means formed on the piston head to enable the coupling to operate in tension for pulling the piston head for loading of the tubular container with liquid through the probe, means being provided for deflecting said claws inwardly to disengage from said complementary engagement means in response to inward movement of the piston rod at the

beginning of a liquid ejection stroke.

According to a fifth aspect of the invention, there is provided a syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the tubular container by movement of the piston, wherein there is provided spring means which is actuable after operation of the syringe for liquid ejection, for retracting the probe into the tubular container, and wherein said probe is bent so that after said retraction into the tubular container the free end of the probe is misaligned with an aperture through which it retracted.

In order that the invention may be more clearly understood some embodiments thereof will now be described by way of example only, with reference to the accompanying drawings, in which:-

Figures 1A to 1E illustrate successive stages in the use of a syringe according to a first embodiment of the invention;

Figures 1AA to 1EE are enlarged fragmentary views of a part of the syringe, showing in greater detail the state of a valve component at the respective stages illustrated by Figures 1A to 1E;

Figures 2A to 2D illustrate successive stages in the use of a modified form of the Figure 1 syringe,

adapted for supply in a pre-filled state, and

Figures 3A to E illustrate successive stages in the use of a syringe according to a second embodiment of the invention.

With reference first to Figure 1, the syringe according to the first embodiment of the invention comprises a tubular syringe barrel 1 which in use acts as a temporary container for syringable material, a piston assembly 2 coaxially and slidably disposed within the syringe barrel 1, and a cylindrical outer sheath 3 which is telescopically fitted onto the outside of the syringe barrel 1. The piston assembly 2 comprises a hollow piston rod 4 and a piston head 5 attached to the lower end of the piston rod 4, this piston head 5 comprising a substantially cylindrical first piston head member 6 and a disc-shaped second piston head element 7 having a peripheral flange 8 which seals against the cylindrical internal surface of the syringe barrel 1 to provide the syringe action. The first piston head element 6 is connected to the lower end of the piston rod 4 by means of an axially projecting coupling extension 9 at the lower end of the piston rod 4, this coupling extension 9 engaging in a complementary recess formed in the upper portion of the first piston head element 6. Likewise, the second piston head element 7 is attached to the first

piston head element 6 by means of a rear projection 10 of the second piston head member 7 which engages in a complementary recess formed in the lower portion of the first piston head element 6.

A hollow probe in the form of a syringe needle 11 projects from a hollow needle holder 12 disposed within the syringe barrel 1. An annular seat member 13 is fixed inside the lower end of the syringe barrel 1, and is shaped and dimensioned internally to receive the lower cylindrical portion of this needle holder 12. In particular, the member 13 is formed with an annular shoulder 14 (see Fig. 1E) for locating the lower annular edge of the needle holder 12.

The inner wall of the syringe barrel 1 is formed a little way along from the end position of the annular seat member 13 with a pawl member 14 constituted by a resilient, inwardly-inclined annular web integrally formed with the barrel wall. The lower edge of this pawl member 14 is urged by its own resilience against the outer surface of an upper cylindrical portion 16 of the needle holder 12, and co-operates with an annular step 17 lying between the cylindrical portion 16 and a larger-diameter central cylindrical portion 18 to hold the needle holder 12 in its lower position, seated in the seat member 13.

At its upper end, the syringe barrel 1 is

integrally formed with an annular, radially projecting flange 19 formed on its underside with a plurality of circumferentially spaced resilient latch fingers 20, the sleeve 3 being formed at its upper end with a similar radially-projecting flange 21 formed with similarly circumferentially spaced apertures 22 for receiving the latch fingers 20. The upper end of the piston rod 2 is also formed with a radial annular flange, to facilitate manual operation of the piston.

The sleeve 3 includes a lower end wall 24 integrally formed with a hollow needle nozzle 25, the lower opening of which is initially sealed by a thin sealing disc 26 of rubber or other pierceable elastomeric material.

A helical compression spring 27 is disposed coaxially with the needle 11 with its upper end engaging the underside of the needle holder 12, and more particularly in a circular recess 28 formed therein. The lower end of the spring 27 engages the inside of the end wall 24, and more particularly it is seated in a circular recess 29 formed therein.

The needle holder 12 incorporates a valve device 30, which is best seen in the enlarged view of Fig. 1AA. This valve device 30 comprises a generally tubular valve element 31 and a valve element support member 32. The support member 32 is constructed for

fixed engagement in the interior of the needle support 12, and serves the purposes of initially holding the valve element 31 in a set position, and subsequently restricting the movement of this valve element, as will be more clearly from the later description of the operation of the syringe.

The support member 32 comprises a cylindrical outer wall 33 which engages tightly with the cylindrical inner wall of the needle holder 12, a central valve stop 34, and a plurality of circumferentially spaced support ribs 35 extending radially between, and integrally formed with, the cylindrical outer wall 33 and the central valve stop 34. The valve stop 34 is formed with an axially extending spigot 34a which initially provides a seat for locating the upper open end of the valve member 31.

The valve member 31, which is made of a suitable flexible material such as natural or synthetic rubber, is integrally formed with a generally upwardly inclined flexible annular valve flap 36 projecting outwardly therefrom, and with a valve nozzle 37 at its lower end. The lower edge of the outer wall portion 33 of the valve support member 32 is inclined upwardly and is spaced from a similarly inclined lower internal surface 38 of the space within the needle holder 12.

This lower edge of wall portion 33 is engageable by the annular valve flap 36 to perform a valve action, as will be explained later.

The operation of the syringe will now be explained in detail. For the purposes of Fig. 1, it is assumed that the syringe is initially supplied empty, so that it must be filled with the liquid to be syringed before the syringe operation takes place.

As can be seen in Fig. 1A the syringe is supplied with the sleeve 3 in its telescopically extended position relative to the syringe barrel 1, the piston rod 2 in a near fully depressed position relative to the syringe barrel 1, and the needle holder 12 seated in the annular seat member 13. As can be seen from Fig. 1A, the second piston head member 7 engages the inner cylindrical wall of the syringe barrel 1 in this condition of the syringe at a position immediately behind the pawl 14. Accordingly, the pawl 14 projects inwardly to engage behind the shoulder 17, thereby holding the needle holder 12 in its lowermost position. As shown in Fig. 1AA, in this initial position the valve member 31 is set on the spigot 34a with its valve flap 36 pressed against the internal surface of the cylindrical wall 33 of the valve support member 32.

The needle 11 is safely accommodated in the lower

end of the sleeve 3 and is maintained sterile by the sealing disc 26 which seals the needle nozzle 25 closed.

The syringe is prepared for use by pushing the flanges 19 and 21 toward one another so as to cause the sleeve 3 to retract telescopically relative to the barrel 1 to its retracted position, which is illustrated in Fig. 1B. During this movement, the needle 11 pierces the sealing disc 26, and the spring 27 becomes compressed, the pawl 14 still acting to hold the needle holder at its lowermost position. The flanges 19 and 21 are brought together until the latch fingers 20 fully enter and engage in the corresponding apertures 22 so as to interlock the sleeve 3 and the barrel in the telescopically retracted position.

In this position, the syringe is ready for filling in the conventional manner, namely by insertion of the needle 11 into an ampule of the syringeable liquid, and subsequent retraction of the piston assembly 2 by the application of outward force F on the flange 23 of the piston rod 4. During filling, the liquid L is drawn through the bore of the needle, into the interior of the needle holder 12, through an annular gap 40 created by inward flexing of the valve flap 36 due to pressure differential across the valve member 31, this gap being formed

between the valve flap 36 and the inner wall of the cylindrical outer wall member 33 of the valve support 32. The liquid then passes through the annular gap lying between the valve stop 34 and the outer wall member 33 (this gap being sub-divided by the radial ribs 35) into the interior of the syringe barrel 1.

When, subsequently, the needle has been made to pierce the patient's skin and is in the required injecting position, the piston rod is pressed inwardly, and the piston assembly thereby performs the injection stroke. Immediately any downward force is applied to the piston rod 4, the pressure created in the liquid L acts upon the upper surface of the valve flap 36, causing the valve member 31 to be forced downwardly off the spigot 34a. As the valve member 31 moves downwardly, the valve flap 36 slips over the lower edge of the cylindrical outer wall member 33, thus causing the valve 30 to become a one-way valve which allows the expulsion of the liquid L through the valve nozzle 37, which is allowed to expand radially under the fluid pressure as seen in Fig. 1DD, but which will prevent any further inward flow of liquid. The reversal of the pressure differential occurring upon an attempt to refill the syringe will cause the valve member 31 to move upwardly so that the valve flap 36 engages with the

lower inclined edge of the wall member 33, and will also cause closure of the valve nozzle 37.

At the end of the liquid injection stroke, the second piston head member 7 applies a radially outwardly directed pressure to the pawl 14, causing it to lie flat against the lower part of the cylindrical wall of the syringe barrel 1. The needle holder 12 is thereby released, as shown in Fig. 1D and can move upwardly under the bias of the compressed spring 27. Subsequent withdrawal of the piston rod 4, as shown in Fig. 1E, is accompanied by further upward movement of the needle holder 12 into the syringe barrel 1 under the action of the spring 27.

Thus, after use of the syringe, the needle is retained safely in the syringe barrel. Further measures can be adopted to ensure that the needle cannot be subsequently extended through the needle nozzle 25, or removed from the upper end of the syringe barrel 1. Thus, the needle is preferably manufactured with a slight bend so that when it is fully retracted as shown in Fig. 1E, the sharpened end lies off-axis, any subsequent downward pressure on the needle holder by pressing of the piston 2 thereby causing the shampered end to impact against the inner surface of the end wall 24 of the sleeve 3. Furthermore, the coupling between the piston rod and

piston head can be adapted to be broken by a sharp twist or pull and/or means (not shown) may be provided projecting radially inwardly from the syringe barrel 1, to prevent removal of the piston head 5 from the barrel 1 after use of the syringe. The needle holder and needle are thereby permanently and irremovably captivated within the syringe barrel 1.

It will be understood from the above that the construction of the described syringe ensures firstly that the syringe can be supplied in a completely safe condition, secondly that it can be used only once for injecting, and thirdly that after use it can be safely disposed of.

With particular reference to the second safety mentioned above, it will further be understood that since the valve 30 is put into a one-way mode immediately upon the application of injecting pressure, the syringe is not susceptible to misuse by repeated partial injection and filling. The syringe barrel 1, sleeve 3, piston rod 4, needle holder 12 and valve support member 32 can all be made from a suitable rigid plastics material. The first piston head member 6, seat member 13, valve member 31 and sealing disc 26 can be made from suitable elastomeric materials having the required properties to enable these elements to perform their required functions.

The second piston head element 7 is preferably made of a flexible plastics material, such as

The syringe described above with reference to Fig. 1 may be adapted for use as a pre-filled syringe, as illustrated in Fig. 2. In this case, the valve 30 does not need to be operable to permit filling of the syringe barrel 1 through the hollow needle 11, and accordingly it is constructed as a permanent one-way valve.

In the modified version shown in Fig. 2, the syringe is supplied pre-filled with liquid L, and again with the sleeve 3 extended relative to the barrel 1 so that the needle 11 is fully shielded. Subsequent retraction of the sleeve 3 onto the barrel 1 causes the needle to project from the needle nozzle 25, and the spring 27 to become compressed. In this condition, shown in Fig. 2B, the syringe is ready for use.

The subsequent operation of the syringe is as for the Fig. 1 syringe, as can be seen from Figs. 2C and 2D.

In the modified construction of Fig. 2, the valve member 31′ simply comprises a tubular part fixedly engaged within the upper part of the needle holder 12′, and a centrally apertured, conical valve nozzle part 37′. This valve element 31′ acts permanently as

a one-way valve preventing re-filling of the syringe after partial emptying. As before, the needle holder 12 is urged by the loaded spring 27 into the syringe barrel 1 after release of the pawl 14 at the end of the injection stroke, as can clearly be seen from Figs. 2C and 2D.

The modified version of Fig. 2 therefore provides the same range of safety features as are present in the Fig. 1 construction.

Figure 3 illustrates a second embodiment of the invention, in which, as in the arrangements of Figs. 1 and 2, a spring 27 becomes loaded when an outer sleeve 3 is telescopically retracted onto a syringe barrel 1 causing projection of the syringe needle 11, and wherein after use a needle holder 12 engaged by the spring 27 is moved into the syringe barrel 1 by expansion of the spring. As before, the syringe barrel 1 is formed internally with an annular pawl 14 which holds the needle holder 12 in engagement with an annular seat member 13 until the end of the injection stroke, whereupon it is released by outward deflection by the piston head 5' to allow the inward movement of the needle holder 12.

The modification in this second embodiment lies in the means adopted for inhibiting re-use of the syringe. This operational feature is attributable to

the form of coupling between the piston head 5' and the piston rod 4'. The needle holder 12' includes no valve device and is constructed simply as a substantially cylindrical bored block in which the end of the syringe needle 11 is fixed.

The coupling between the piston rod 4' and the piston head 5' is by means of a connector 50 which is captive in the lower end of the hollow piston rod 4', and which has a central rod 56 and a pair of outwardly inclined claws 51 projecting from an aperture in the lower end of the rod 4', these claws 51 being inter-engageable with and under an inwardly projecting annular barbed flange 52 integrally formed with the upper portion of the first piston head member 6'. The second piston head member 7' is formed with a rearwardly projecting pin 53 which serves firstly to fix the first and second members 6' and 7' together, and secondly to properly locate the claws 51 relative to the member 5'.

The connector 50 is provided with a pair of pawls 54 for engaging an internal shoulder 55 formed adjacent the lower end of the piston rod 4', and each of the claws 51 is formed between its lower free end and its upper end attached to the main central rod 56 with an upwardly projecting barb 57, the purpose of which will become clear from the following

description.

In the mutual arrangement of the components in the supplied condition of the syringe (see Fig. 3A) the piston head 5' is nearly at its lowermost position, and the pawls 51 are in engagement with the barbed flange 52. After the needle has been exposed and inserted into an ampule of the syringeable liquid, the piston rod 4' is pulled outwardly to load the syringe, and the connector 50 acts in tension to transmit the outward pulling force to the piston head 5'.

When, after filling, inward pressure is applied to the piston rod 4' it is pushed downwardly with the edges of the aperture 60 formed in its lower end engaging the upper surfaces of the claws 51 while the connector 50 remains seated on the locating pin 53. This engagement urges the claws inwardly toward the locating pin 53, and the aperture edge 60 rides over the barbs 57; the claws 51 become disengaged from the barbed flange 52, and the lower end of the rod 4' seats in the aperture defined by the flange 52, as shown in Fig. 3D. It should be noted that this relative movement between the piston rod, piston head and connector 50 occurs immediately downward pressure is applied to the piston rod, ie. at the <u>beginning</u> of the injection stroke. Once rearrangement of

components has taken place, the piston rod 4' can only push the piston head 5' so as to perform the injection stroke; the engagement of the barbs 57 behind the aperture 60 prevents the claws 51 from extending outwardly again to engage the barbed flange 52. Accordingly, any subsequent outward force applied to the piston rod will cause it to separate from the piston head, as shown in Fig. 3E.

Thus the configuration of the piston rod 4', piston head 5' and connector 50 provides a coupling in which, following loading of the liquid by an outward piston stroke in which the coupling acts in tension, a compression force applied to the coupling renders the coupling incapable of acting again in tension for subsequent loading of the syringe.

When, at the end of the injection stroke, the needle carrier is allowed by the outward deflection of the pawls 14 to be pushed inwardly by the spring 27, it also pushes the piston head 5' back towards the open end of the syringe barrel 1. The piston rod can be removed from the barrel 1, the piston head 5' being trapped therein so as effectively to constitute a permanent stopper trapping the used needle 11 in the barrel 1. As before, the needle 11 is slightly bent so as to prevent its re-extension from the needle nozzle 25.

It will be apparent to those skilled in the art that many modifications to the above-described arrangements may be made without departing from the scope of the present invention.

CLAIMS:

1. A syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the container by movement of the piston, wherein there is also provided a valve arranged for or capable of one-way operation for passing the liquid to be ejected, and for inhibiting the inward flow of liquid into the container from the probe.

2. A syringe according to claim 1 wherein said valve is mounted in a probe holder from which the probe projects.

3. A syringe according to claim 1 or claim 2 wherein said valve has a selectively openable liquid flow passage which opens to permit said outward flow of liquid, and closes to inhibit said inward flow.

4. A syringe according to claim 3 wherein said passage automatically opens or closes in accordance with the pressure differential across the valve, the reduction of liquid pressure in the tubular container upon attempted re-filling by piston withdrawal causing said closure of said passage.

5. A syringe according to any of claims 1 to 4 wherein said valve is adapted to permit an initial inward flow of the syringeable liquid through the

probe for loading of the tubular container, and to be put into its one-way mode permitting only outward flow of liquid in response to pressurisation of the liquid loaded into the container.

6. A syringe according to claim 5 wherein said valve includes a valve member and means for retaining said valve member so as to be displaceable between a first position in which it permits said initial inward flow of liquid into the tubular container, and a second position in which it acts as a said one-way valve, said valve member being displaceable from said first to said second position in response to said pressurisation of liquid within said tubular container.

7. A syringe according to any of claims 1 to 4, adapted for use as a pre-filled syringe, wherein said valve is adapted to act as a permanent one-way valve to permit only outward flow of liquid through the probe.

8. A syringe according to any preceding claim, including means for selectively shielding the probe.

9. A syringe according to claim 8 wherein said shielding means comprises an outer sleeve disposed telescopically relative to the tubular container.

10. A syringe according to claim 9 wherein the probe initially projects axially from the tubular

container and the sleeve is telescopically retractable relative to the tubular container to expose the probe, and wherein the probe is subsequently retractable into the tubular container.

11. A syringe according to claim 10 including spring means arranged to be loaded by said telescopic retraction of the sleeve and to provide a driving force for the subsequent retraction of the probe into the tubular container.

12. A syringe according to claim 10 or claim 11, including means for interlocking the sleeve and the tubular container in their telescopically retracted mutual positions.

13. A syringe according to any of claims 10 to 12 including releasable means for retaining the probe in its said position projected from the tubular container, said retaining means being releasable at the end of a liquid ejection stroke of the piston to permit the subsequent retraction of the probe into the tubular container.

14. A syringe according to claim 13 wherein said probe is carried by and projects from a probe holder, and wherein said retaining means is releasably engageable with said probe holder to retain the probe in its said projected position, said retaining means being releasable upon displacement by a piston head

member of said piston.

15. A syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the tubular container by movement of the piston, wherein the piston includes a slidable piston head and a piston rod coupled to the piston head by a coupling which is operable to act only one-way in compression to push the piston head for ejection of the liquid, thereby to inhibit subsequent re-loading of liquid into the tubular container, and wherein there is provided means for retracting the probe into the tubular container after operation of the syringe for liquid ejection.

16. A syringe according to claim 15 wherein the coupling is adapted initially to operate in tension to allow the piston to be pulled outwardly for loading of the tubular container with liquid through the probe, said coupling being responsive to pressure applied at the beginning of liquid ejection to be irreversibly changed so as thereafter to act only one-way in compression.

17. A syringe according to claim 16 wherein said coupling comprises a connector for connecting the piston head and piston rod to enable the piston head to be pulled by the piston rod, the connector being

disengageable in response to said applied pressure.

18. A syringe according to claim 17 wherein said connector has at least one engagement element engageable in a first position thereof with the piston head for transmitting a pulling force to the head for loading the tubular container with liquid through the probe, and displaceable to another position disengaged from the piston head in response to relative movement between the connector and the piston rod which is brought about by an initial inward movement of the piston rod.

19. A syringe according to claim 18 wherein a plurality of said engagement elements is provided, each of them comprising a displaceable claw projecting from the end of the piston rod through an aperture in the part of the piston head facing said end of the piston rod, and engageable in its said one position under an inwardly projecting annular flange defining said aperture.

20. A syringe according to claim 19 wherein said piston rod is hollow and is formed at its end with an aperture through which a portion of said connector comprising said engagement elements projects, the or each said engagement element being arranged to be deflected inwardly by sliding engagement with the edge

of said aperture of the piston rod.

21. A syringe according to any of claims 15 to 20 including means for selectively shielding the probe.

22. A syringe according to claim 21 wherein said shielding means comprises an outer sleeve disposed telescopically relative to the tubular container.

23. A syringe according to claim 22 wherein the probe initially projects axially from the tubular container and the sleeve is telescopically retractable relative to the tubular container to expose the probe.

24. A syringe according to claim 23 including spring means arranged to be loaded by said telescopic retraction of the sleeve and to provide a driving force for the subsequent retraction of the probe into the tubular container.

25. A syringe according to claim 23 or claim 24 including means for interlocking the sleeve and the tubular container in their telescopically retracted mutual positions.

26. A syringe according to any of claims 23 to 25 including releasable means for retaining the probe in its said position projected from the tubular container, said retaining means being releasable at the end of a liquid ejection stroke of the piston to permit the subsequent retraction of the probe into the

tubular container.

27. A syringe according to claim 26 wherein said probe is carried by and projects from a probe holder, and wherein said retaining means is releasably engageable with said probe holder to retain the probe in its said projected position, said retaining means being releasable upon displacement by a piston head member of said piston.

28. A syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from said tubular container by movement of the piston, wherein there is provided a tubular sleeve fitted telescopically on the tubular container and arranged in a telescopically extended position thereof to shield the probe extending from the tubular container, spring means being arranged to be loaded by the telescopic retraction of the sleeve relative to the tubular container for exposure of the probe, the probe being arranged to retract into the tubular container by the action of the loaded spring.

29. A syringe according to claim 28 including releasable means for retaining the probe in its said position projecting from the tubular container, said retaining means being releasable at the end of a liquid ejection stroke of the piston to permit the

subsequent retraction of the probe into the tubular container.

30. A syringe according to claim 29 wherein said probe is carried by and projects from a probe support, and wherein said retaining means is releasably engageable with said probe support to retain the probe in its said projected position, said retaining means being releasable upon displacement by a piston head member of said piston.

31. A syringe according to any of claims 28 to 30 wherein said spring means comprises a compression spring arranged to be compressed by said telescopic retraction and to expand so as to push the probe into the tubular container.

32. A syringe according to any of claims 28 to 31, including means for interlocking the sleeve and the tubular container in said telescopically retracted mutual positions.

33. A syringe according to any of claims 10 to 32, wherein said probe is bent so that after retraction into the tubular container the free end of the probe is misaligned with an aperture through which it retracted.

34. A syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid

ejected from the tubular container by movement of the piston, wherein the piston includes a slidable piston head and a piston rod coupled to the piston head by a coupling which is operable to act only one-way in compression to push the piston head for ejection of the liquid, thereby to inhibit subsequent re-loading of liquid into the tubular container, said coupling comprising a connector which is attached to and projects from one end of the piston rod, and which includes a plurality of outwardly-facing, inwardly-deflectable claws arranged in their relatively outwardly-projecting positions to engage with complementary engagement means formed on the piston head to enable the coupling to operate in tension for pulling the piston head for loading of the tubular container with liquid through the probe, means being provided for deflecting said claws inwardly to disengage from said complementary engagement means in response to inward movement of the piston rod at the beginning of a liquid ejection stroke.

35. A syringe comprising a tubular container for syringeable liquid, a piston slidable in said tubular container and a hollow probe for conveying liquid ejected from the tubular container by movement of the piston, wherein there is provided spring means which is actuable after operation of the syringe for liquid

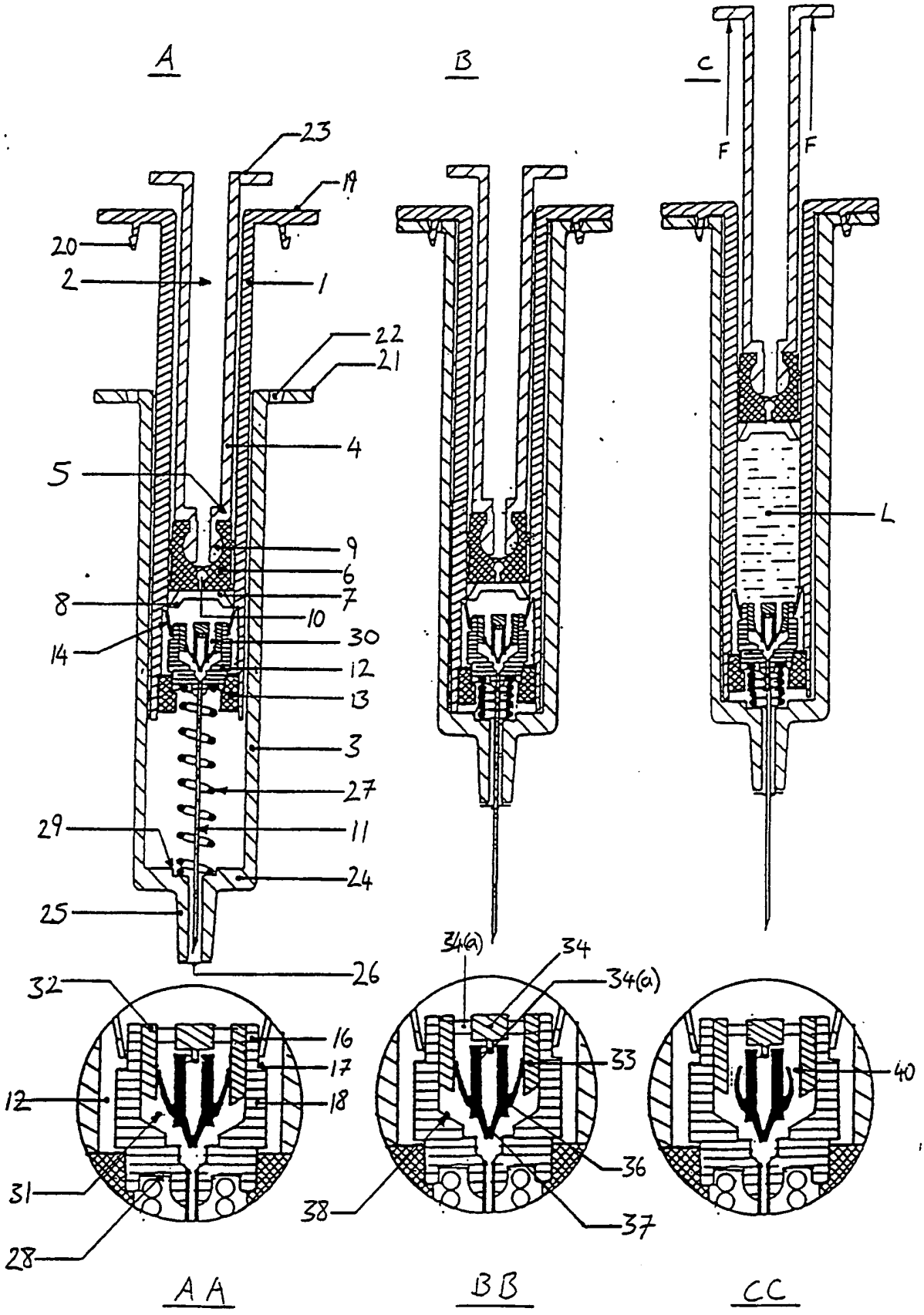
ejection, for retracting the probe into the tubular container, and wherein said probe is bent so that after said retraction into the tubular container the free end of the probe is misaligned with an aperture through which it retracted.

36. A syringe substantially as hereinbefore described with reference to Fig. 1 of the accompanying drawings.

37. A syringe substantially as hereinbefore described with reference to Fig. 2 of the accompanying drawings.

38. A syringe substantially as hereinbefore described with reference to Fig. 3 of the accompanying drawings.

FIG 1.


A
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C
23
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3
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29
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26
F
F
L
34(a)
34
34(a)
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18
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40
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37
28
AA
BB
CC

FIG 1. C'ntd

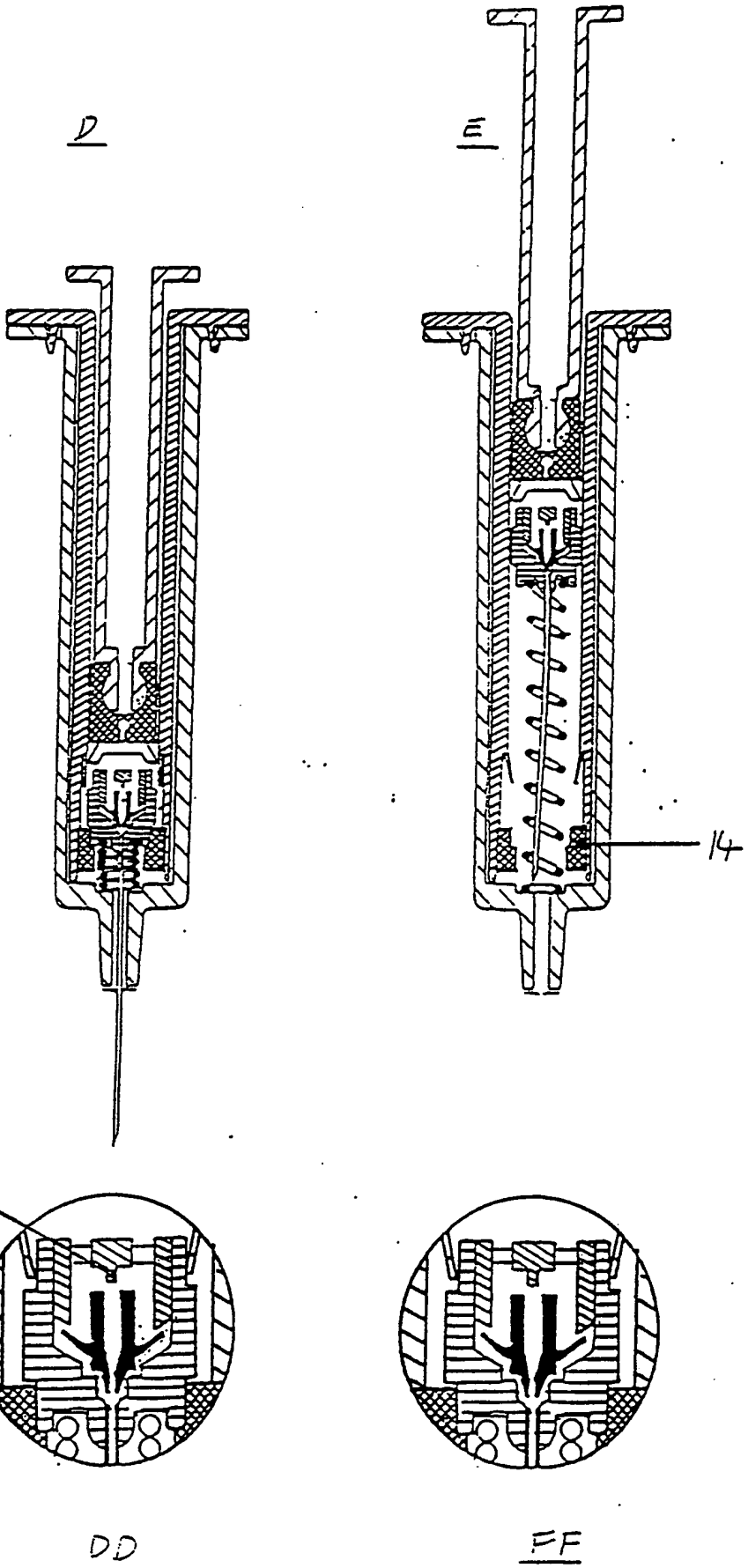


FIG 2

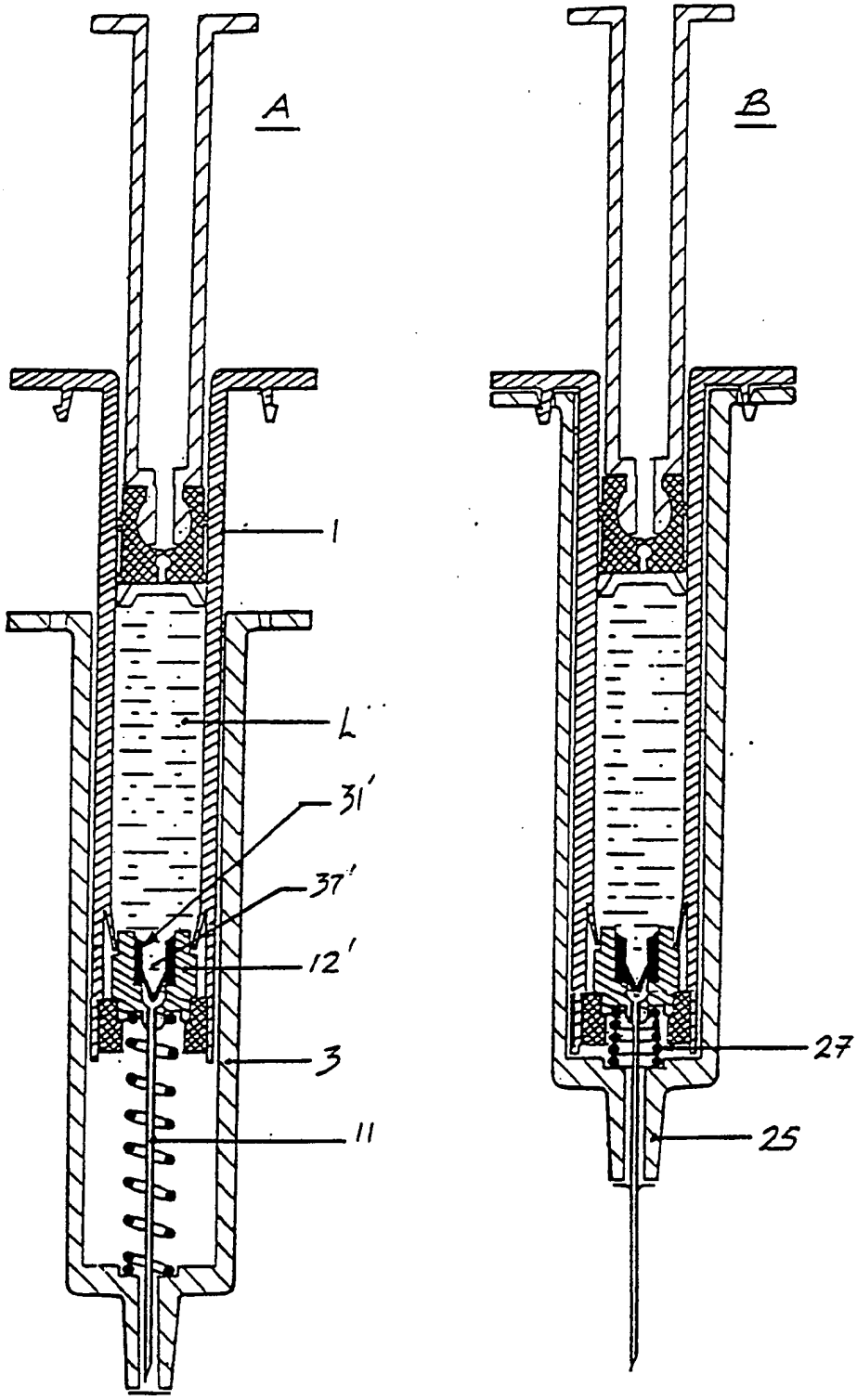


FIG 1. C'ntd

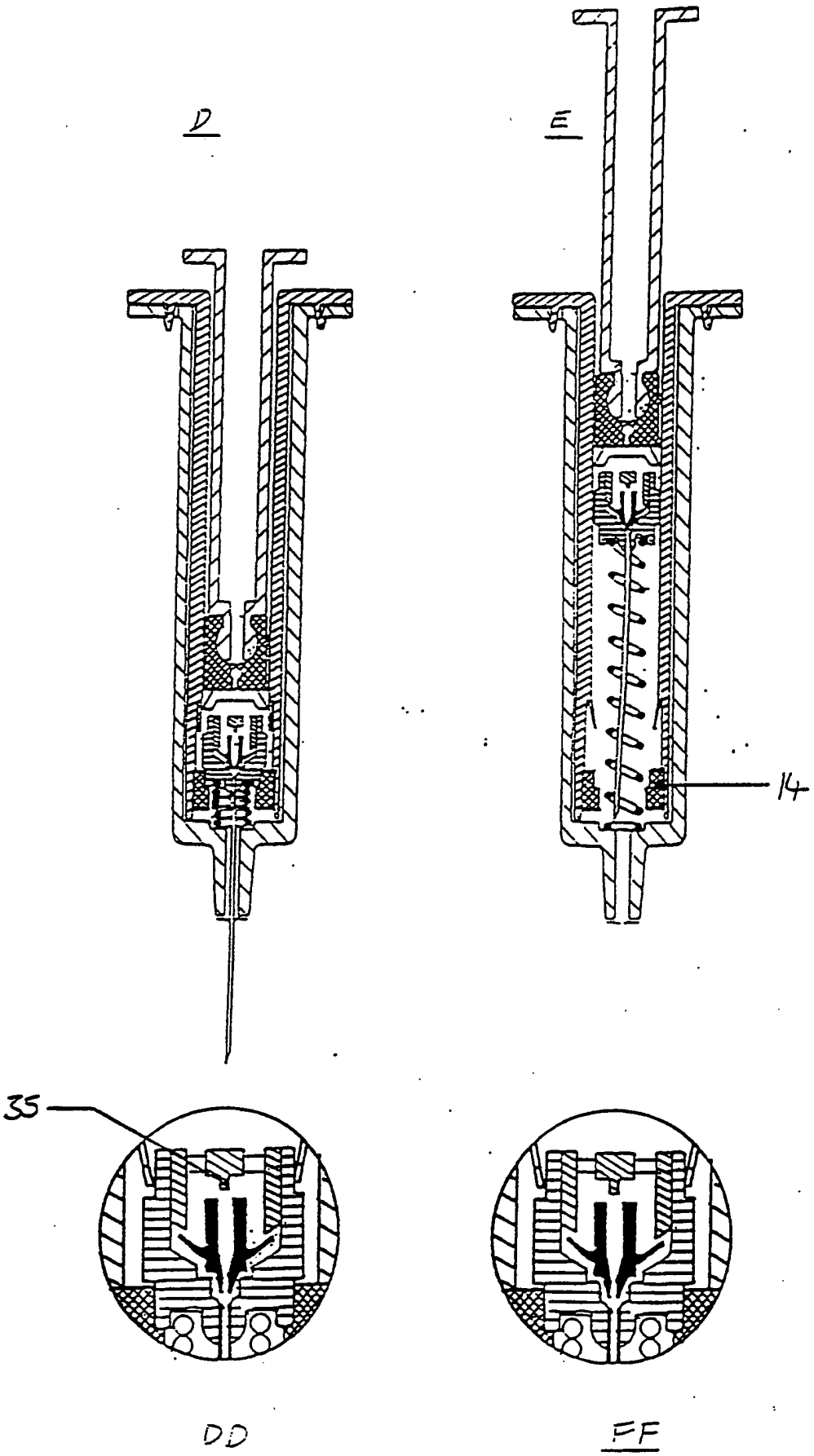


FIG 3

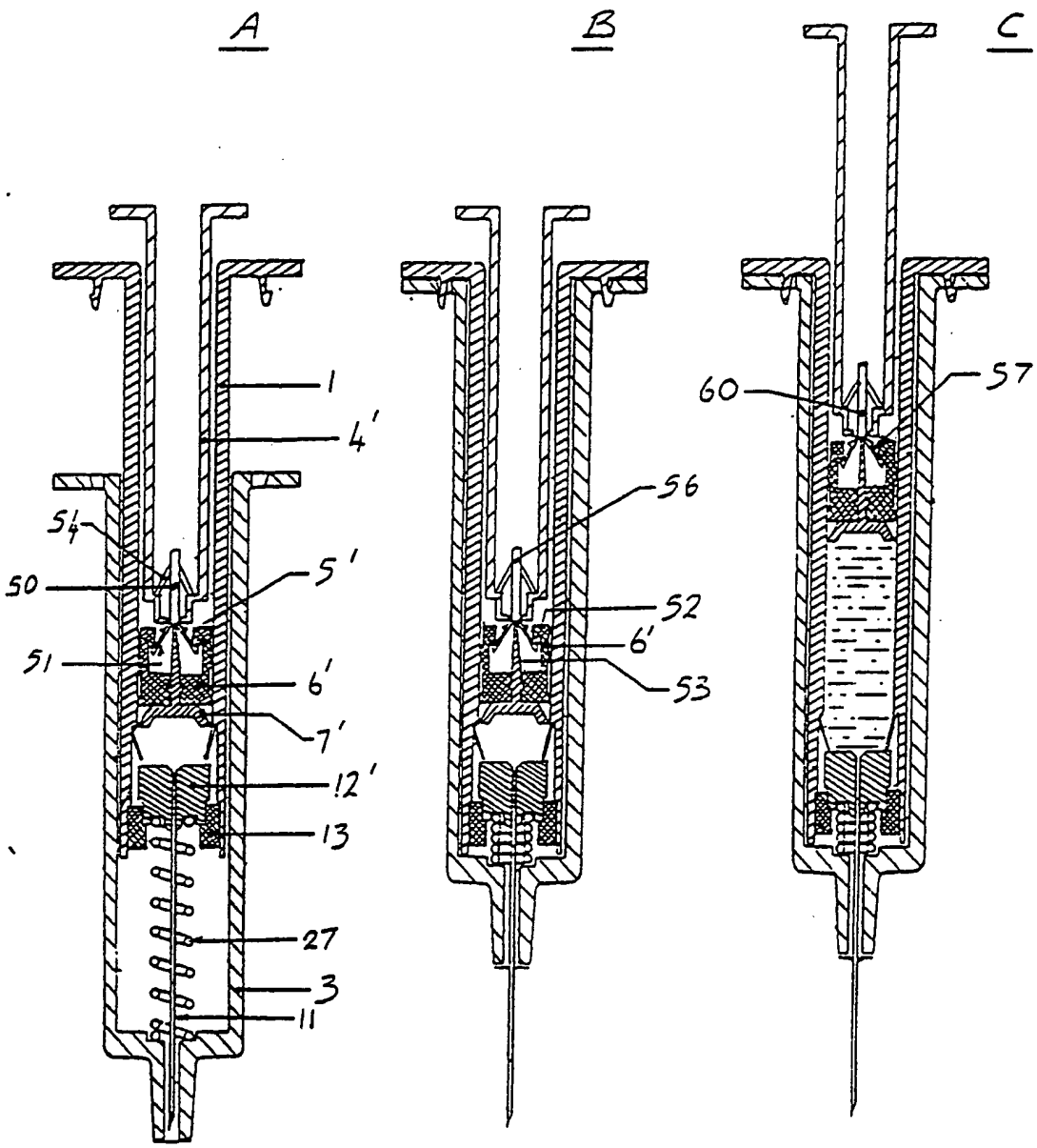
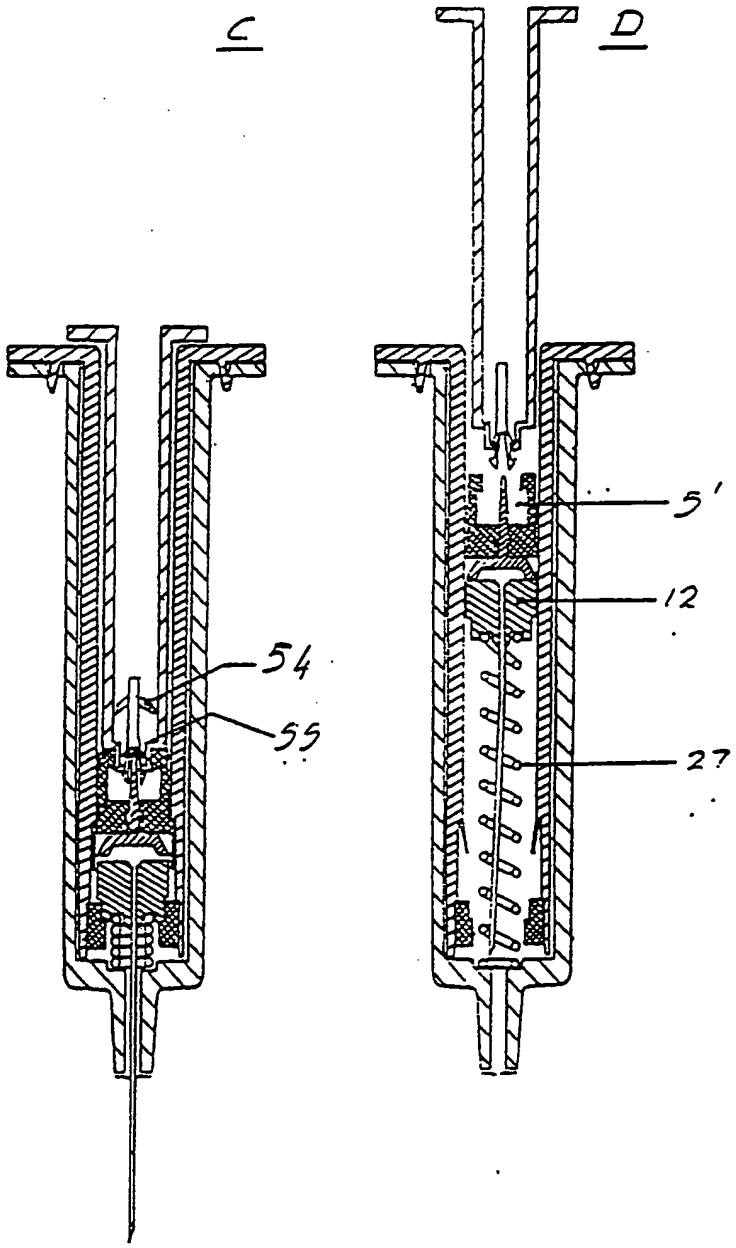


FIG 3 C'ntd



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